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Lee et al.

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(54) **LIGHT EMITTING DEVICE PACKAGE AND LIGHTING DEVICE FOR VEHICLE INCLUDING THE SAME**

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H01L 25/075	(2006.01)

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(52) **U.S. Cl.**

CPC . ***H01L 33/08*** (2013.01); ***F21K 9/50*** (2013.01); ***F21S 48/2212*** (2013.01); ***F21V 23/005*** (2013.01); ***H01L 27/156*** (2013.01); ***H01L 33/50*** (2013.01); *H01L 25/0753* (2013.01); *H01L 33/20* (2013.01); *H01L 33/504* (2013.01); *H01L 33/508* (2013.01); *H01L 2224/48091* (2013.01); *H01L 2224/48227* (2013.01); *H01L 2224/73265* (2013.01)

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USPC 257/98
See application file for complete search history.

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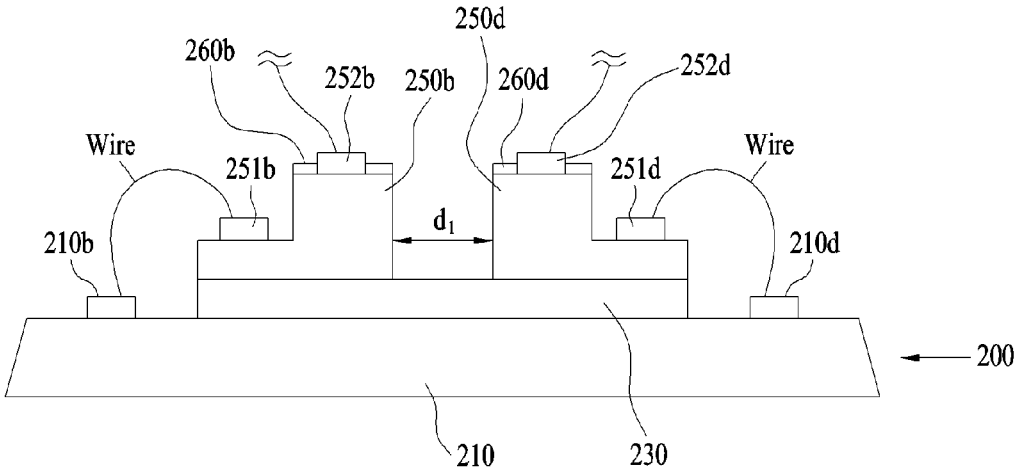
(57) **ABSTRACT**

Embodiments relate to a light emitting device package including a package body, a light emitting structure disposed on the package body, the light emitting structure including a first conductive semiconductor layer, an active layer and a second conductive semiconductor layer, the light emitting structure being divided into at least two light emitting cells, a support substrate located between the package body and the light emitting structure, a first electrode and a second electrode connected to each of the light emitting cells and fluorescent substances disposed respectively on the light emitting cells. At least two layers among the first conductive semiconductor layer, the active layer and the second conductive semiconductor layer included in each of the light emitting cells next to each other are electrically separated from each other.

19 Claims, 10 Drawing Sheets



(51) **Int. Cl.**
H01L 33/20 (2010.01)
H01L 33/50 (2010.01)

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Fig. 1A

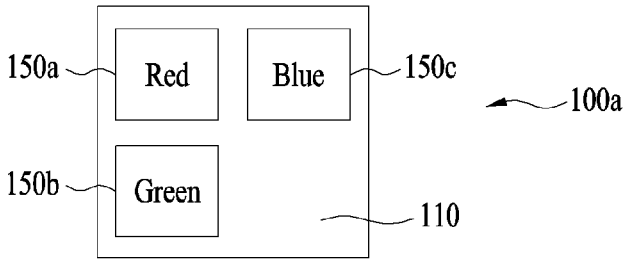


Fig. 1 B

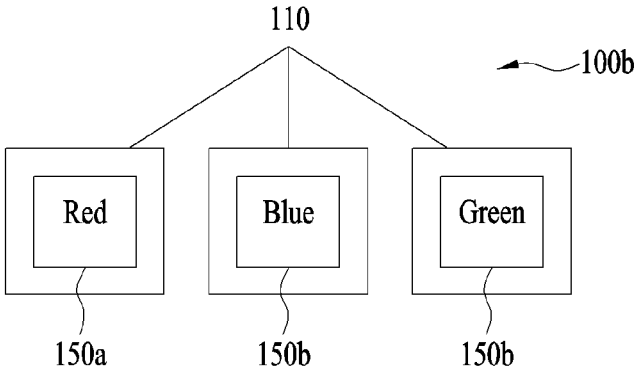


Fig. 2 A

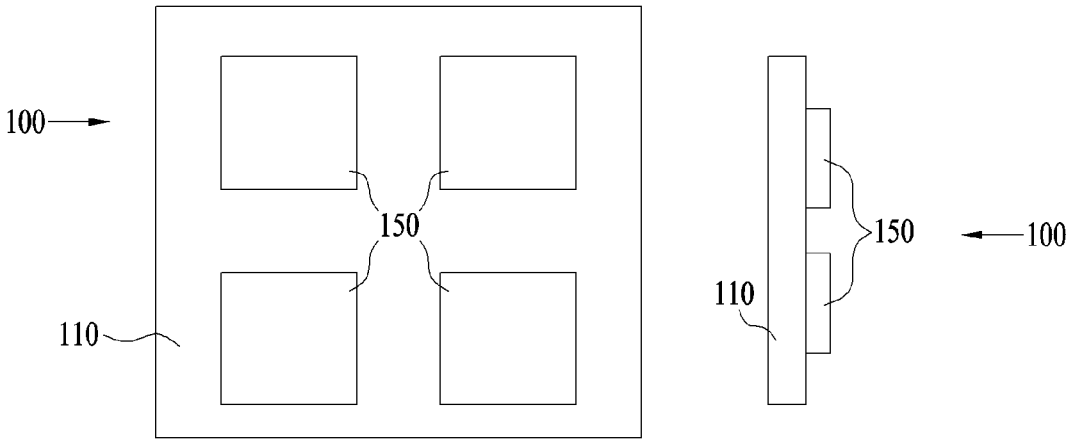


Fig. 2 B

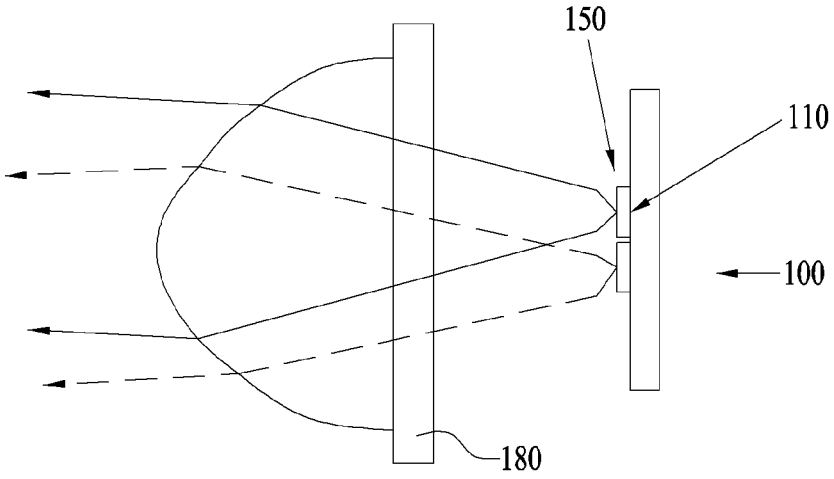


Fig. 3

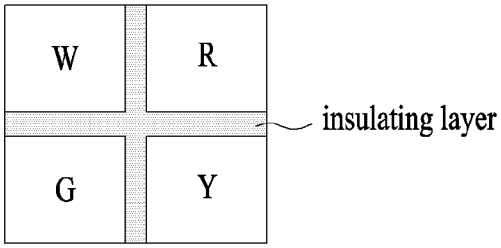


Fig. 4

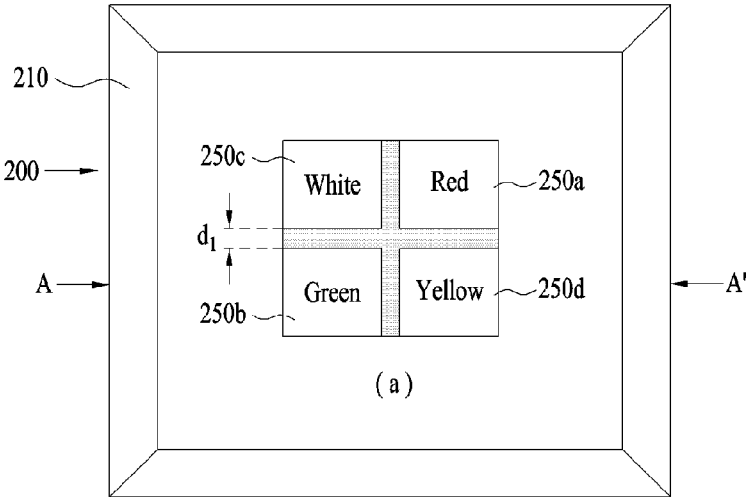
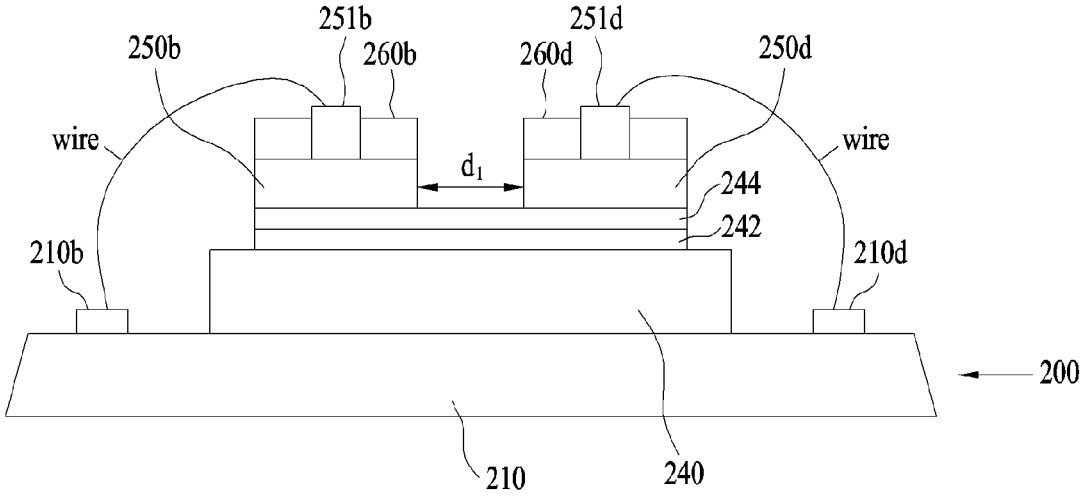


Fig. 5 A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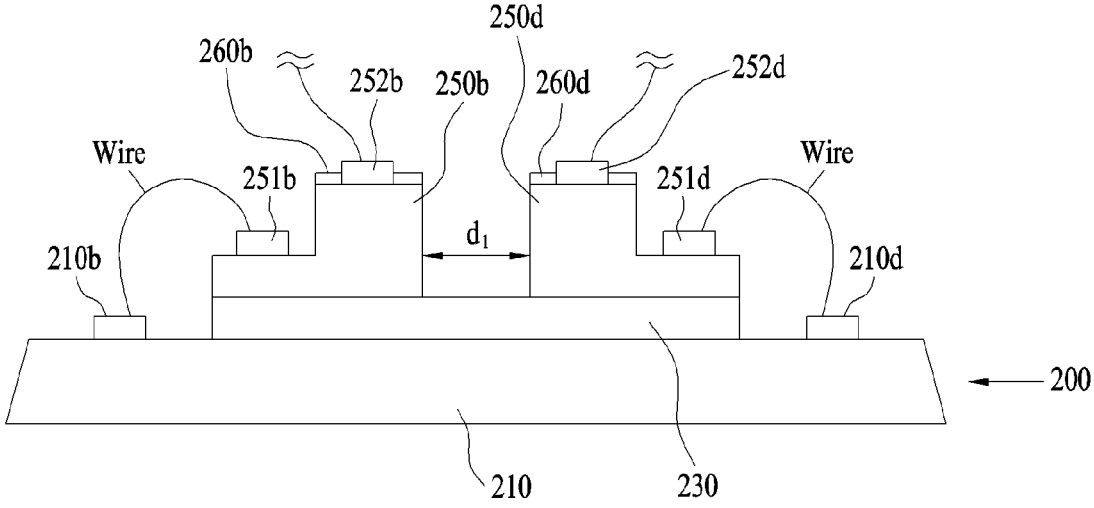
251d
250b
260b
260d
250d
wire
wire
d_1
244
242
210b
210d
200
210
240

Fig. 5 B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260d
252d
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Wire
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251d
d_1
210b
210d
200
210
230

Fig. 6 A

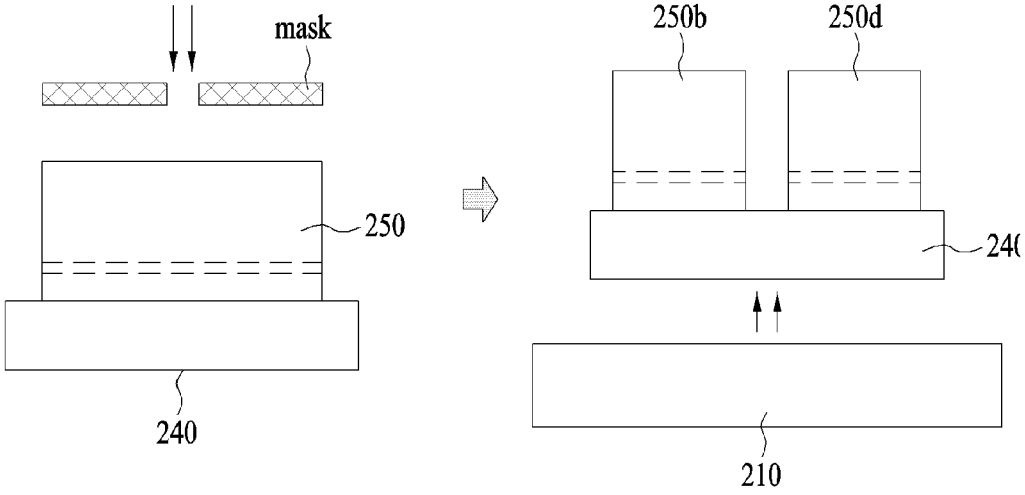


Fig. 6 B

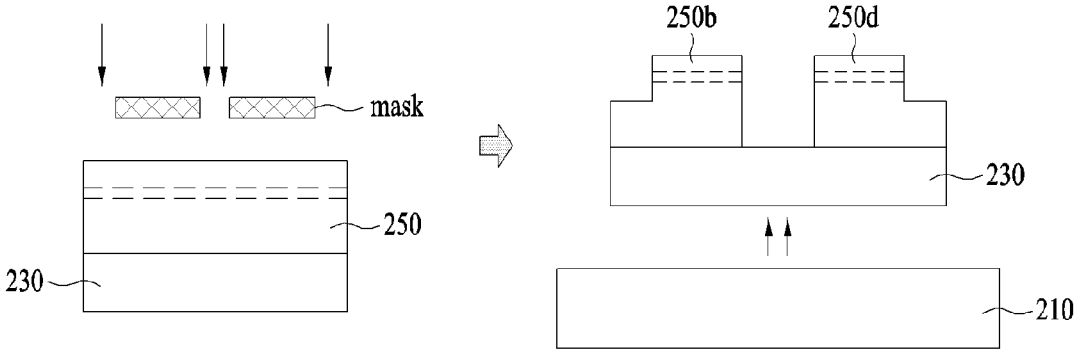
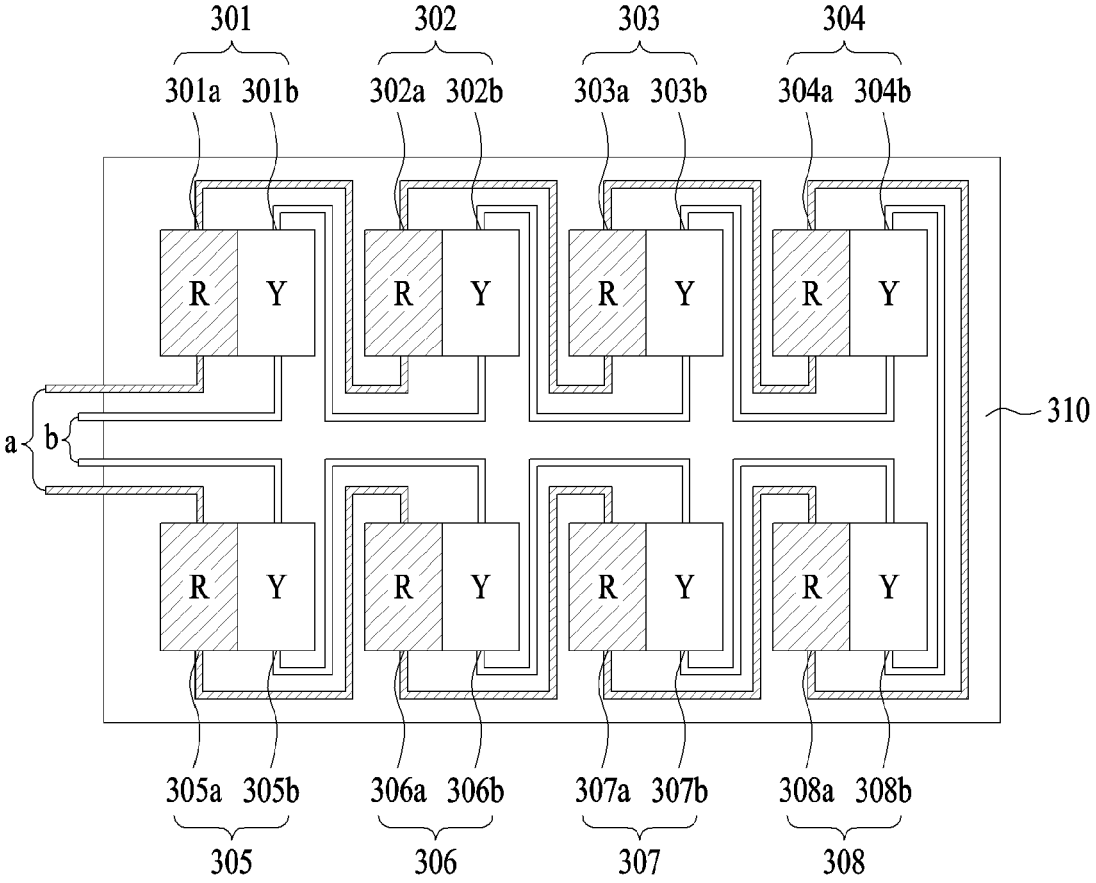


Fig. 7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301a 301b
302a 302b
303a 303b
304a 304b
R Y
a
b
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308a 308b
305
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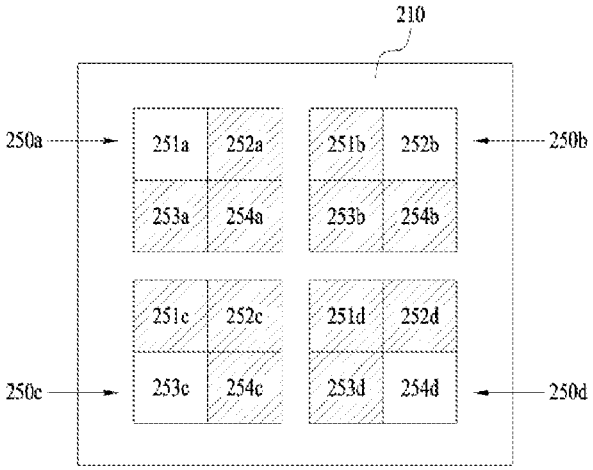
307
308

Fig. 8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250d
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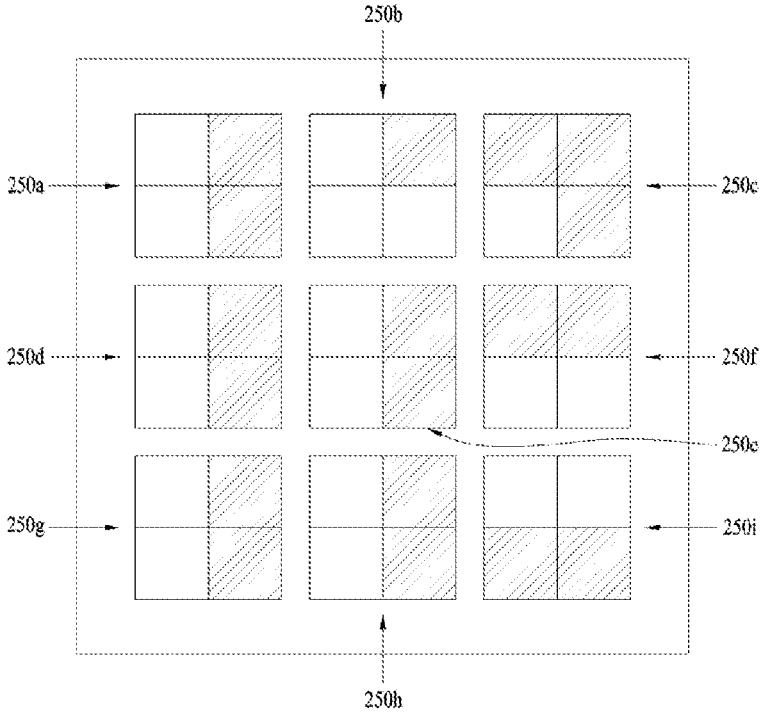
251b 252b 253b 254b
251c 252c 253c 254c
251d 252d 253d 254d

Fig. 9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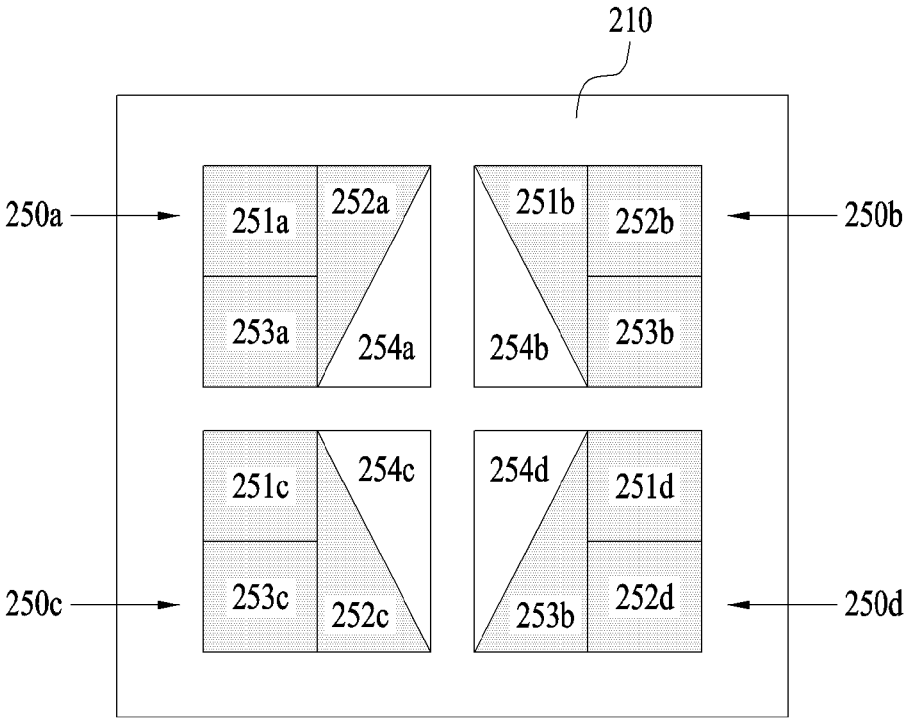
250i
250h

Fig. 10A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250d

Fig. 10B

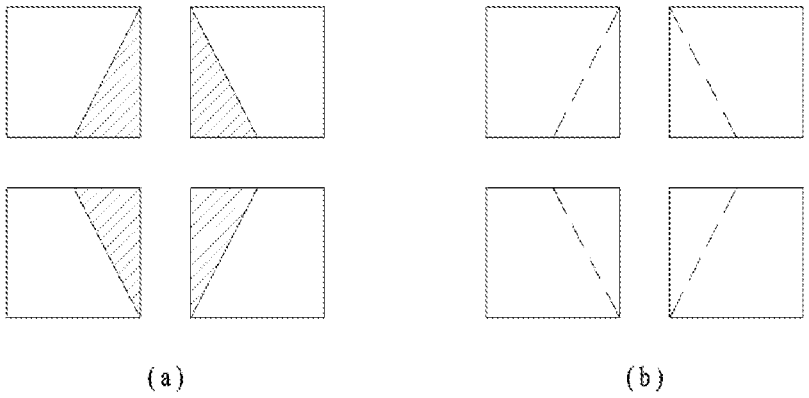


Fig. 11A

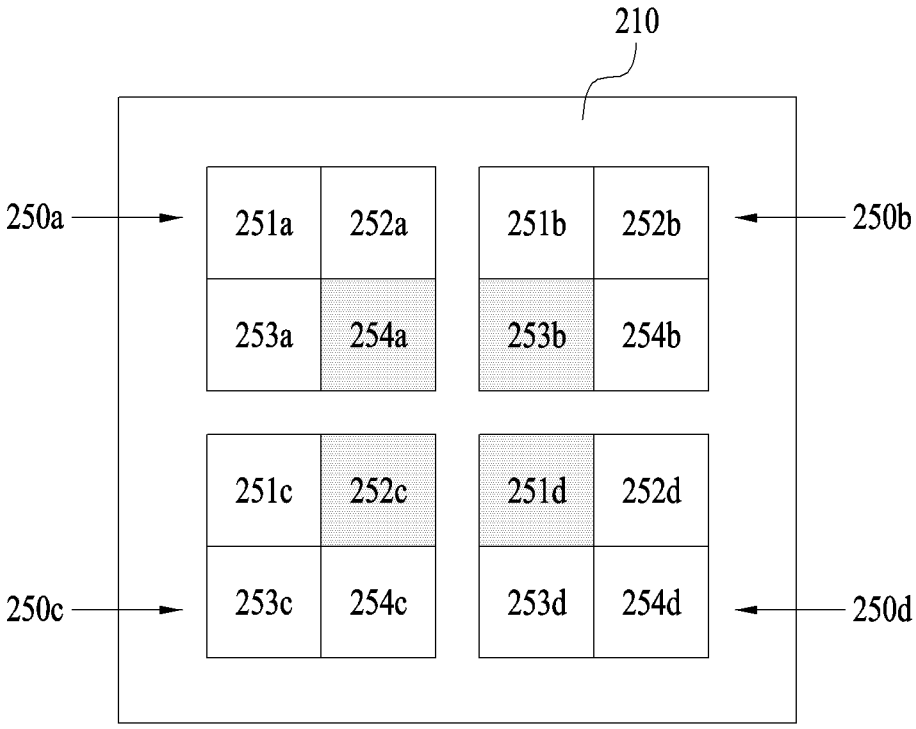


Fig. 11B

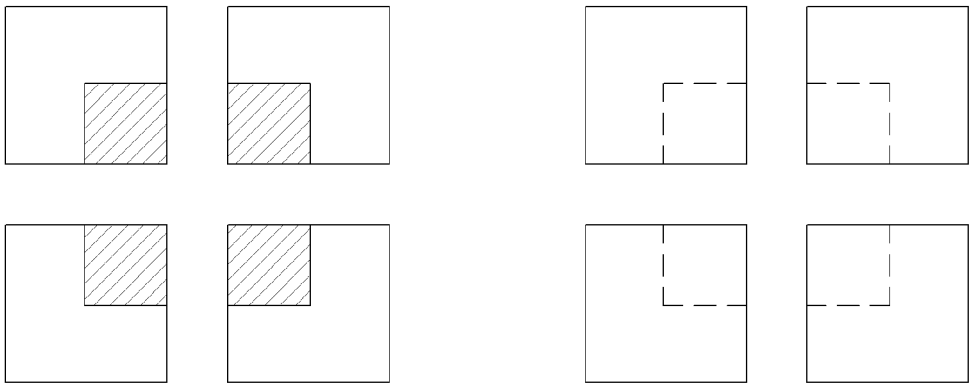


Fig. 12A

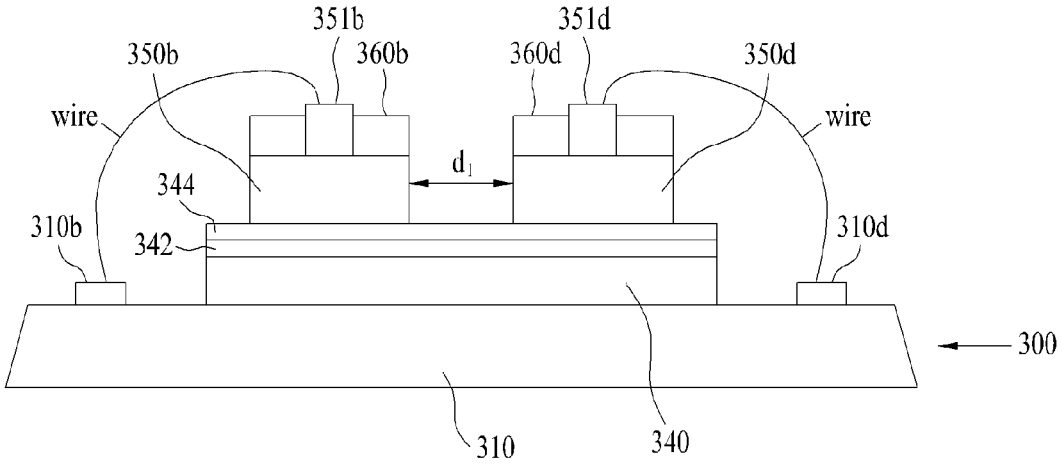


Fig. 12B

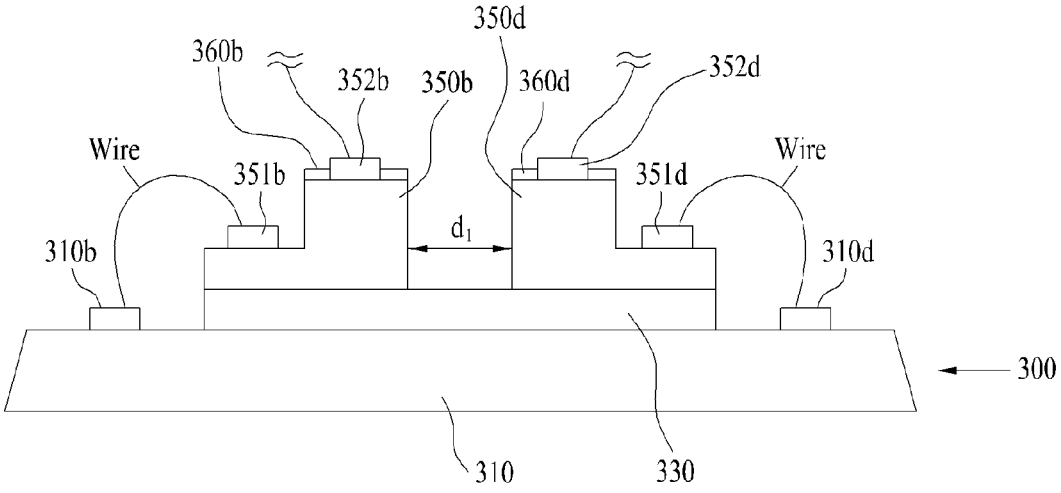


Fig. 13A

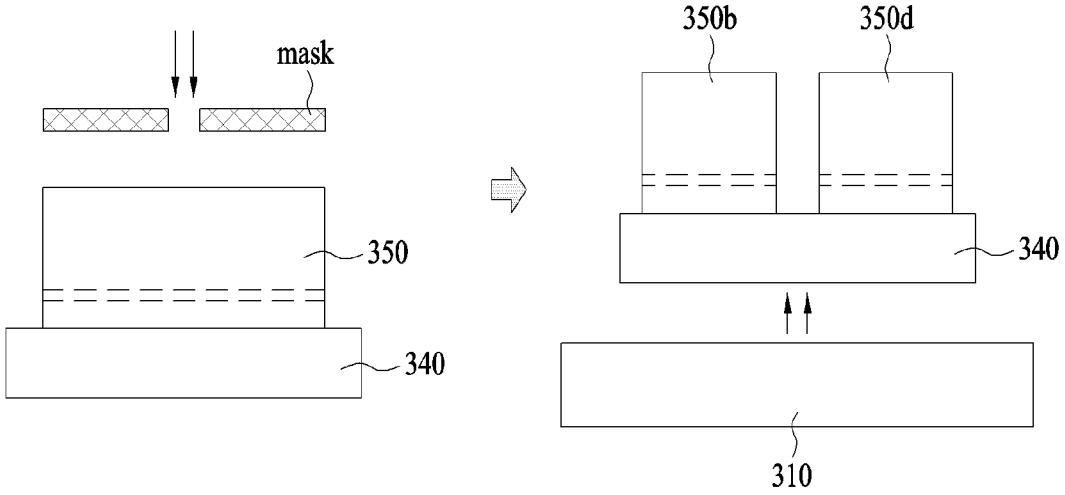


Fig. 13B

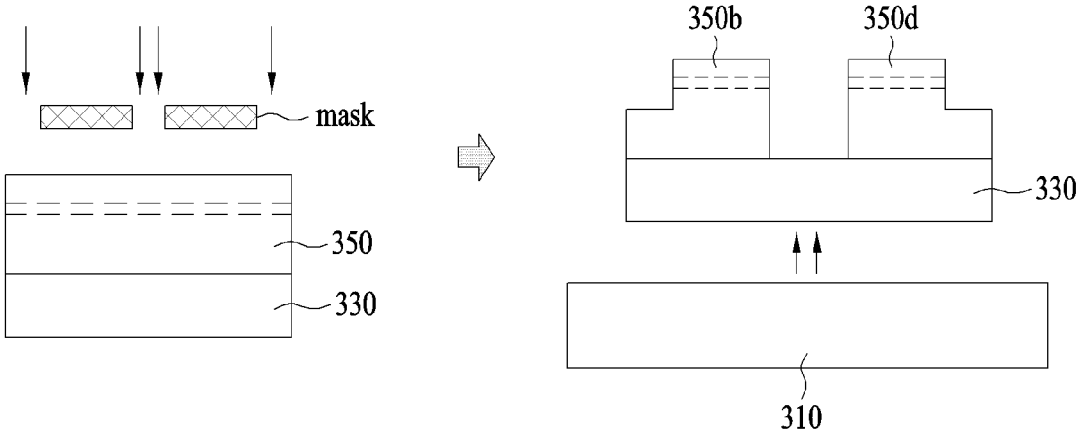
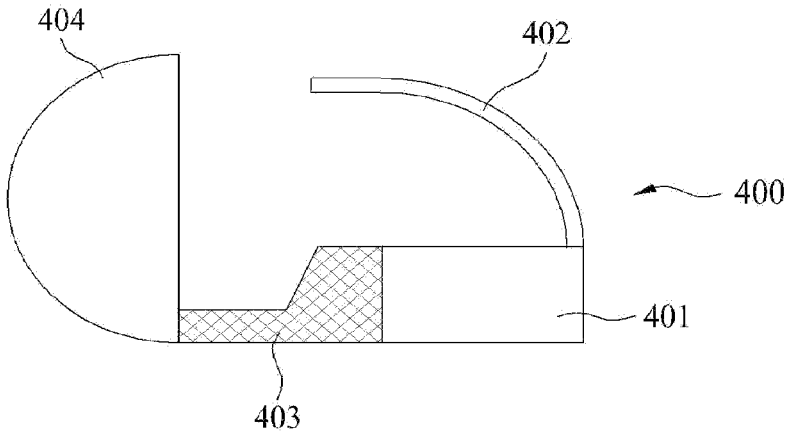


Fig. 14



LIGHT EMITTING DEVICE PACKAGE AND LIGHTING DEVICE FOR VEHICLE INCLUDING THE SAME

CROSS REFERENCE TO RELATED APPLICATION

This application claims priority under 35 U.S.C. §119 to Korean Patent Application No. 10-2013-0103830, filed in Korea on Aug. 30, 2013, and No. 10-2013-0103831, filed in Korea on Aug. 30, 2013, which are hereby incorporated in its entirety by reference as if fully set forth herein.

TECHNICAL FIELD

Embodiments relate to light emitting device packages and lighting devices for vehicles including the same.

BACKGROUND

Light emitting devices, such as Light Emitting Diodes (LEDs) or Laser Diodes (LDs), which use group III-V or group II-VI compound semiconductors, are capable of emitting light of various colors, such as red, green and blue, ultraviolet light and the like, owing to developments of device materials and thin film growth technologies. Moreover, these light emitting devices are capable of emitting white light with high efficiency through use of a fluorescent substance or color combination, and have advantages of low power consumption, semi-permanent lifespan, fast response time, safety and environmental friendliness as compared to conventional light sources, such as fluorescent lamps, incandescent lamps and the like.

Accordingly, application sectors of light emitting devices are expanded up to transmitting modules of optical communication means, LED backlights to replace Cold Cathode Fluorescence Lamps (CCFLs) which serve as backlights of Liquid Crystal Display (LCD) apparatuses, white LED lighting apparatuses to replace fluorescent lamps or incandescent lamps, head lights of vehicles and traffic lights.

A light emitting device includes a light emitting structure including a first conductive semiconductor layer, an active layer and a second conductive semiconductor layer sequentially stacked on a substrate formed of sapphire or the like, and a first electrode and a second electrode are respectively disposed on the first conductive semiconductor layer and the second conductive semiconductor layer.

A light emitting device package includes a first electrode and a second electrode disposed on the top of a package body and a light emitting device disposed on the bottom of the package body, the first electrode and the second electrode being electrically connected to each other.

FIGS. **1**A and **1**B are views showing conventional light emitting device packages.

In case of a light emitting device package **100** provided with a plurality of light emitting devices **150***a*, **150***b* and **150***c*, the light emitting devices **150***a*, **150***b* and **150***c* are arranged on a substrate **110** and spaced apart from one another by a prescribed distance. The light emitting devices **150***a*, **150***b* and **150***c* may emit light of the same wavelength range or light of different wavelength ranges.

For example, when attempting to white light from a light emitting device package, as exemplarily shown in FIG. **1**A, three light emitting devices **150***a*, **150***b* and **150***c* to emit red, green and blue light of different wavelength ranges respectively may be arranged on a single substrate **110**. Alternatively, the three light emitting devices **150***a*, **150***b* and **150***c* to emit red, green and blue light of different wavelength ranges may be arranged respectively on different substrates **110**.

In this case, the three light emitting devices **150***a*, **150***b* and **150***c* may emit light of different wavelength ranges from active layers thereof, or may include different kinds of fluorescent substances disposed on the active layers that emit light of the same wavelength range.

When a plurality of light emitting devices to emit light of different wavelength ranges is used in a single light emitting device package as described above, design limits and increase in cost may be expected.

In particular, in case of rear lighting devices for vehicles that are adapted to emit light of various colors in various shapes within a narrow space, there may be technical limits with regard to close arrangement of light emitting devices to emit light of different wavelength ranges.

FIG. **2**A is a view showing a conventional light emitting device package.

In case of a light emitting device package **100** provided with a plurality of light emitting devices **150**, the light emitting devices **150** are arranged on a substrate **110** and spaced apart from one another by a prescribed distance. The respective light emitting devices **150** may emit light of the same wavelength range or light of different wavelength ranges.

FIG. **2**B is a view showing a conventional light source module.

In the shown light source module, a lens **180** may be located in front of the light emitting device package **100** and serve to change a progress path of light emitted from the respective light emitting devices **150**. In particular, when used in lighting devices for vehicles, the lens **180** may be an aspheric lens that directly transmits light from the light emitting devices **150** and, thus, the shape of light sources of the light emitting devices **150** may be important.

However, light sources of light emitting devices typically have a rectangular or square shape and are limited in the emission shape of light to be transmitted outward. In addition, there may be technical limits with regard to close arrangement of respective light emitting devices.

SUMMARY

Embodiments provide light emitting device packages and lighting devices for vehicles including the same, which achieve an increased degree of freedom in terms of arrangement of light sources, diversification in the emission shape of light to be transmitted outward from light sources and reduced manufacturing costs.

In one embodiment, a light emitting device package includes a package body, a light emitting structure disposed on the package body, the light emitting structure including a first conductive semiconductor layer, an active layer and a second conductive semiconductor layer, the light emitting structure being divided into at least two light emitting cells, a support substrate located between the package body and the light emitting structure, a first electrode and a second electrode connected to each of the light emitting cells and fluorescent substances disposed respectively on the light emitting cells, wherein at least two layers among the first conductive semiconductor layer, the active layer and the second conductive semiconductor layer included in each of the light emitting cells next to each other are electrically separated from each other.

The respective light emitting cells may emit light of the same wavelength range, and at least some portions of the fluorescent substances disposed respectively on the light emitting cells may emit light of different wavelength ranges.

The light emitting cells may be formed by growing a single light emitting structure and then dividing the grown light emitting structure via etching.

The fluorescent substances may take the form of a conformal coating or a film.

A distance of the light emitting cells next to each other may be 10 μm to 50 μm.

The light emitting device package may further include a substrate for placement of the light emitting structure, and each of the light emitting cells may be mesa-etched such that the second conductive semiconductor layer, the active layer and a portion of the first conductive semiconductor layer are etched to expose a portion of the first conductive semiconductor layer, and the second electrode and the first electrode may be respectively disposed on the second conductive semiconductor layer in an unetched region and the exposed first conductive semiconductor layer in an etched region of the light emitting cell.

The light emitting device package may further include a conductive support substrate for placement of the light emitting structure, and the first electrode may be disposed on the first conductive semiconductor layer of each of the light emitting cells.

In another embodiment, a lighting device for a vehicle includes a circuit board, a light emitting device package as described above disposed on the circuit board, and a lens disposed on the light emitting device package, wherein the at least one light emitting structure includes two or more light emitting structures, each of the light emitting structures is configured to emit light of a blue wavelength range, and the respective light emitting cells are provided with at least a yellow fluorescent substance and a red fluorescent substance.

Each of the light emitting structures may include a first light emitting cell provided with the yellow fluorescent substance and a second light emitting cell provided with a red fluorescent substance, and the first light emitting cell and the second light emitting cell in the light emitting structure may be equally arranged.

The first light emitting cell and the second light emitting cell may be driven independently of each other.

In a further embodiment, a light emitting device package includes a package body, at least one light emitting structure disposed on the package body, the light emitting structure including a first conductive semiconductor layer, an active layer and a second conductive semiconductor layer, the light emitting structure being divided into at least two light emitting cells, a first electrode and a second electrode connected to each of the light emitting cells and fluorescent substances disposed respectively on at least some portions of the light emitting cells, wherein the light emitting cells differ from one another in terms of at least one of a shape of the cells and a distance between the cells.

The respective light emitting cells may have a square shape or a triangular shape.

The active layers of the respective light emitting cells may emit light of the same wavelength range, and at least some portions of the fluorescent substances disposed respectively on the light emitting cells may emit light of different wavelength ranges.

The light emitting cells may include a first light emitting cell provided with a first fluorescent substance to emit light of a first wavelength range and a second light emitting cell provided with a second fluorescent substance to emit light of a second wavelength range, and at least one of the first light emitting cell and the second light emitting cell may indicate a specific emblem.

The light emitting cells having different shapes may be provided with fluorescent substances to emit light of the same wavelength range or light of different wavelength ranges.

The light emitting cells having the same shape may be provided with fluorescent substances to emit light of the same wavelength range or light of different wavelength ranges.

The light emitting cells may be formed by growing a single light emitting structure and then dividing the grown light emitting structure via etching.

The fluorescent substances may take the form of a conformal coating or a film.

The at least one light emitting structure may include a first light emitting structure and a second light emitting structure, and some light emitting cells in the first light emitting structure and some light emitting cells in the second light emitting structure may indicate a direction indicating emblem.

Some light emitting cells in the first light emitting structure and some light emitting cells in the second light emitting structure may indicate a break signal emblem.

BRIEF DESCRIPTION OF THE DRAWINGS

Arrangements and embodiments may be described in detail with reference to the following drawings in which like reference numerals refer to like elements and wherein:

FIGS. **1**A and **1**B are views showing conventional light emitting device packages;

FIG. **2**A is a view showing a conventional light emitting device package;

FIG. **2**B is a view showing a conventional light source module;

FIG. **3** is a view schematically showing a configuration of light emitting cells in a light emitting device package according to an embodiment;

FIG. **4** is a view showing a first embodiment of a light emitting device package;

FIGS. **5**A and **5**B are views showing a first embodiment and a second embodiment of a configuration of light emitting cells in a light emitting structure of a light emitting device package;

FIGS. **6**A and **6**B are views showing a first embodiment and a second embodiment of a manufacturing process of light emitting cells in a light emitting structure of a light emitting device package;

FIG. **7** is a view showing one embodiment of arrangement of light emitting devices in a lighting device for vehicles;

FIGS. **8** and **9** are views showing a second embodiment and a third embodiment of a light emitting device package;

FIGS. **10**A and **10**B are views showing on and off states of a fourth embodiment of a light emitting device package;

FIGS. **11**A and **11**B are views showing on and off states of a fifth embodiment of a light emitting device package;

FIGS. **12**A and **12**B are views showing a second embodiment to a fifth embodiment of a configuration of light emitting cells in a light emitting structure of a light emitting device package;

FIGS. **13**A and **133** are views showing a manufacturing process of the light emitting cells shown in FIGS. **12**A and **12**B; and

FIG. **14** is a view showing one embodiment of a lighting device for vehicles containing the light emitting device package according to the above-described embodiments.

DESCRIPTION OF SPECIFIC EMBODIMENTS

Hereinafter, embodiments to concretely realize the above object will be described with reference to the accompanying drawings.

In the following description of the embodiments, it will be understood that, when each element is referred to as being formed "on" or "under" the other element, it can be directly "on" or "under" the other element or be indirectly formed with intervening one or more other elements therebetween. Also, it will also be understood that "on" or "under" the element may mean an upward direction and a downward direction of the element.

In the drawings, the thickness or size of each layer may be exaggerated, omitted or schematically illustrated for clarity and convenience. In addition, the size of each constituent element does not wholly reflect an actual size thereof.

FIG. **3** is a view schematically showing a configuration of light emitting cells in a light emitting device package according to an embodiment.

In the light emitting device package according to the embodiment, a single light emitting device may be divided into a plurality of light emitting cells, e.g., four light emitting cells W, R, G and Y as exemplarily shown in FIG. **3**, and the respective light emitting cells W, R, G and Y may be separated from one another with an insulating layer interposed between the light emitting cells W, R, G and Y. The aforementioned light emitting cells may be formed by growing a single light emitting structure and dividing the same by etching. Since the single light emitting structure emits light of the same wavelength range, the respective light emitting cells may be respectively provided with fluorescent substances to emit light of different wavelength ranges. In this manner, the florescent substances on the light emitting cells are separated from one another by the insulating layer.

FIG. **4** is a view showing a first embodiment of a light emitting device package.

The light emitting device package **200** according to the present embodiment includes a single light emitting device disposed on a package body, such as, e.g. a substrate **210**. Alternatively, a plurality of light emitting devices may be disposed, and at least one light emitting device may be divided into a plurality of light emitting cells.

In FIG. **4**, a single light emitting device may be divided into four light emitting cells **250***a* to **250***d* and the respective light emitting cells may emit red, green, white and yellow light of different wavelength ranges. To allow the respective light emitting cells **250***a* to **250***d* to emit light of different wavelength ranges, a light emitting structure emits light of the same wavelength range and the respective light emitting cells **250***a* to **250***d* are provided with different fluorescent substances. The fluorescent substances may emit light of different wavelength ranges when excited by the above-described light of the same wavelength range and, in turn, the respective light emitting cells **250***a* to **250***d* may emit light of different wavelength ranges.

For example, when an active layer of the light emitting device emits light of a blue wavelength range, the first light emitting cell **250***a* may be provided with a fluorescent substance that is excited by light of the blue wavelength range to emit light of a wavelength range between 550 nm and 565 nm, the second light emitting cell **250***b* may be provided with a fluorescent substance that is excited by light of the blue wavelength range to emit light of a wavelength range between 620 nm and 650 nm, the third light emitting cell **250***c* may be provided with a fluorescent substance that is excited by light of the blue wavelength range to emit light of a wavelength range between 510 nm and 540 nm, and the fourth light emitting cell **250***d* may be provided with a fluorescent substance that is excited by light of the blue wavelength range to emit light of a wavelength range between 590 nm and 600 nm.

The light emitting cells **250***a* to **250***d* are separated from each other and spaced apart from one another by a predetermined distance dl. The predetermined distance dl may be within a range of 10 μm to 50 μm. An excessively great distance has substantially less difference in comparison with manufacturing respective light emitting cells using separate light emitting devices, and an excessively small distance may cause difficulty in separation of light emitting cells during etching.

FIGS. **5**A and **5**B are views showing a first embodiment and a second embodiment of a configuration of light emitting cells in a light emitting structure of a light emitting device package.

FIG. **5**A shows a vertical light emitting device and FIG. **5**B shows a horizontal light emitting device, each light emitting device including a plurality of light emitting cells placed therein. FIGS. **5**A and **5**B may be vertical cross sectional views taken in direction A-A' of FIG. **4**.

In FIG. **5**A, two light emitting cells **250***b* and **250***d* are separately disposed above a single conductive support substrate **240** that is, in turn, disposed on a substrate **210**. The light emitting cells **250***b* and **250***d* are spaced apart from each other by a predetermined distance dl. A conductive bonding layer **242** and a second electrode **244** may be sequentially stacked on the conductive support substrate **240** and the light emitting cells **250***b* and **250***d* may be disposed on the second electrode **244**.

A first electrode **251***b* may be formed on one light emitting cell **250***b*. The first electrode **251***b* may be bonded to a first bonding pad **210***b* on the substrate **210** via a wire and a fluorescent substance **260***b* may be disposed on the light emitting cell **250***b*. The fluorescent substance **260***b*, for example, may be a green fluorescent substance.

A first electrode **251***d* may be formed on the other light emitting cell **250***d*. The first electrode **251***d* may be bonded to a first bonding pad **210***d* on the substrate **210** via a wire and a fluorescent substance **260***d* may be disposed on the light emitting cell **250***d*. The fluorescent substance **260***d*, for example, may be a yellow fluorescent substance.

In the vertical light emitting device of FIG. **5**A, the first electrode may be formed over a first conductive semiconductor layer in a light emitting structure.

In FIG. **5**B, two light emitting cells **250***b* and **250***d* are separately disposed on an insulating substrate **230** formed of sapphire or the like that is, in turn, disposed on a substrate **210**. The light emitting cells **250***b* and **250***d* are spaced apart from each other by a predetermined distance dl.

One light emitting cell **250***b* may be subjected, at a region thereof, to mesa-etching such that a first electrode **251***b* is disposed on the mesa-etched region, and a second electrode **252***b* may be formed on the light emitting cell **250***b*. The first electrode **251***b* may be bonded to a first bonding pad **210***b* on the substrate **210** via a wire, the second electrode **252***b* may be bonded to a second bonding pad (not shown) on the substrate **210** via a wire, and a fluorescent substance **260***b* may be disposed on the light emitting cell **250***b*. The fluorescent substance **260***b*, for example, may be a green fluorescent substance.

The other light emitting cell **250***d* may be subjected, at a region thereof, to mesa-etching such that a first electrode **251***d* is formed on the mesa-etched region, and a second electrode **252***d* may be formed on the light emitting cell **250***d*. The first electrode **251***d* may be bonded to a first bonding pad **210***d* on the substrate **210** via a wire, the second electrode **252***d* may be bonded to a second bonding pad (not shown) on the substrate **210** via a wire, and a fluorescent substance **260***d*

may be disposed on the light emitting cell **250***d*. The fluorescent substance **260***d*, for example, may be a yellow fluorescent substance.

In the horizontal light emitting device of FIG. **5**B, each light emitting cell is mesa-etched such that a second conductive semiconductor layer, an active layer and a portion of a first conductive semiconductor layer are etched to expose a portion of the first conductive semiconductor layer. Then, a second electrode and a first electrode may be disposed respectively on the second conductive semiconductor layer in an unetched region and the exposed first conductive semiconductor layer in the etched region of the light emitting cell.

In the above-described light emitting device packages, the first electrodes and the second electrodes, connected to the respective light emitting cells, may be connected in parallel or may be independent of each other, thereby allowing the respective light emitting cells to be driven individually. As will be appreciated from, e.g., FIGS. **5**A and **5**B, the fluorescent substances may take the form of a conformal coating or a film.

The light emitting device package according to the present embodiment in which a plurality of light emitting cells is formed in a single light emitting device may emit various colors of light within a narrow space and employ a reduced number of light emitting devices, which, in turn, enables change of design in a limited space on the substrate and reduction of manufacturing costs.

FIGS. **6**A and **6**B are views showing a first embodiment and a second embodiment of a manufacturing process of light emitting cells in a light emitting structure of a light emitting device package.

A light emitting structure including a first conductive semiconductor layer, an active layer and a second conductive semiconductor layer may be grown and then divided into a plurality of light emitting cells via etching that will be described below.

FIG. **6**A shows division of light emitting cells in a vertical light emitting device. A light emitting structure **250** may be disposed on a conductive semiconductor substrate **240** that is in turn disposed on a substrate **210**. The light emitting structure **250** may be selectively etched using a mask to thereby be divided into two light emitting cells **250***b* and **250***d* as exemplarily shown in the right side of the drawing.

More specifically, the light emitting structure **250** may be grown on a growth substrate (not shown) and mounted on the conductive support substrate **240**. After the growth substrate is removed via LLO or the like, the light emitting structure **250** is divided into unit cells by etching and formation of electrodes, application of fluorescent substances and the like may be performed.

Then, as exemplarily shown in the right side of the drawing, the conductive support substrate **240** is mounted on the substrate **210** and wire bonding and the like may be performed.

In another embodiment, after the conductive support substrate **240** including the light emitting structure **250** mounted thereon is fixed on the substrate **210**, the light emitting structure **250** is divided into unit cells and formation of electrodes, application of fluorescent substances and the like may be performed.

FIG. **6**B shows division of light emitting cells in a horizontal light emitting device. A light emitting structure **250** may be disposed on an insulating substrate **230** and selectively etched using a mask or via mesa-etching to thereby be divided into two light emitting cells **250***b* and **250***d* as exemplarily shown in the right side of the drawing. Subsequently, some regions of the respective light emitting cells **250***b* and **250***d* may be mesa-etched.

Then, after the insulating substrate **230** is mounted on the substrate **210** as exemplarily shown in the right side of the drawing, wire bonding and the like may be performed.

In another embodiment, after the insulating substrate **230** is mounted on the substrate **210**, the above-described etching process may be performed.

FIG. **7** is a view showing one embodiment of arrangement of light emitting devices in a lighting device for vehicles.

A light emitting device package according to the present embodiment includes eight light emitting devices **301** to **308** disposed on a substrate **310** and the light emitting devices **301** to **308** respectively include two light emitting cells **301***a*/**301***b* to **308***a*/**308***b*.

For example, first light emitting cells **301***a* to **308***a* may emit red light R and second light emitting cells **301***b* to **308***b* may emit yellow light Y. The red light R and yellow light Y may be acquired via combination of light emitted from an active layer in each light emitting device and light emitted from an excited fluorescent substance on the light emitting device.

Although FIG. **7** shows the first light emitting cells **301***a* to **308***a* and the second light emitting cells **301***b* to **308***b* as coming into contact with each other, the first light emitting cells **301***a* to **308***a* and the second light emitting cells **301***b* to **308***b* of the respective light emitting devices **301** to **308** may be spaced apart from each other by a predetermined distance as described above.

In addition, the first light emitting cells **301***a* to **308***a* and the second light emitting cells **301***b* to **308***b* may be driven independently of each other. In FIG. **7**, the first light emitting cells **301***a* to **308***a* may be connected to one line a and the second light emitting cells **301***b* to **308***b* may be connected to the other line b.

The lighting device for vehicles, which includes the light emitting device package shown in FIG. **7**, more particularly, a rear lamp for vehicles may emit red light using the eight first light emitting cells **301***a* to **308***a* upon receiving current applied to the line a. In particular, the red light may indicate a break signal. In addition, the rear lamp may emit yellow light using the eight second light emitting cells **301***b* to **308***b* upon receiving current applied to the line b. In particular, the yellow light may indicate a break signal.

Hereinafter, a second embodiment to a fifth embodiment of a light emitting device package will be described. In the light emitting device package according to the embodiments, each light emitting device disposed on a substrate may be divided into a plurality of light emitting cells and fluorescent substances to emit light of a plurality of wavelength ranges may be disposed on the respective light emitting cells. As such, the single light emitting device may emit light of the different wavelength ranges. In addition, the light emitting cells are arranged in any of various shapes rather than a rectangular or square shape, thus achieving a light source having any of various shapes.

FIGS. **8** and **9** are views showing a second embodiment and a third embodiment of a light emitting device package.

The light emitting device package according to the second embodiment includes a first light emitting device to a fourth light emitting device **250***a*, **250***b*, **250***c* and **250***d* disposed on a substrate **210**. The first light emitting device **250***a* may include four light emitting cells **251***a*, **252***a*, **253***a* and **254***a*, the second light emitting device **250***b* may include four light emitting cells **251***b*, **252***b*, **253***b* and **254***b*, the third light emitting device **250***c* may include four light emitting cells

251*c*, **252***c*, **253***c* and **254***c*, and the fourth light emitting device **250***d* may include four light emitting cells **251***d*, **252***d*, **253***d* and **254***d*.

A first fluorescent substance may be disposed on one light emitting cell **251***a*, **252***b*, **253***c* or **254***d* of each of the first to fourth light emitting devices **250***a*, **250***b*, **250***c* and **250***d*, and a second fluorescent substance may be disposed on the other light emitting cells. The first fluorescent substance and the second fluorescent substance are adapted to emit light of a first wavelength range and light of a second wavelength range when excited by light emitted from active layers of the respective light emitting devices **250***a*, **250***b*, **250***c* and **250***d*. Thus, the light emitting cells provided with the first fluorescent substance may outwardly emit a mixture of light emitted from the active layer and light of the first wavelength range, and the light emitting cells provided with the second fluorescent substance may outwardly emit a mixture of light emitted from the active layer and light of the second wavelength range.

The light emitting device package according to the third embodiment may include a first light emitting device to a ninth light emitting device **250***a* to **250***i* disposed on a substrate **210**, and the light emitting devices **250***a* to **250***i* may respectively include four light emitting cells.

The light emitting cells of the respective light emitting devices **250***a* to **250***i* may be sorted into two kinds of light emitting cells to emit light of different wavelength ranges. Similar to the light emitting device package according to the above-described second embodiment, different fluorescent substances to emit light of different wavelength ranges may be disposed on the respective light emitting cells.

In addition, some of the light emitting cells may be provided with the fluorescent substance and the other light emitting cells may be provided with no fluorescent substance. The light emitting cells may be spaced apart from one another by different distances. That is, a distance between the light emitting cells of the same light emitting device may be less than a distance between the light emitting cells of the neighboring light emitting devices.

In the embodiment shown in FIG. **9**, when light is emitted from the active layers of the respective light emitting devices **250***a* to **250***i*, the fluorescent substances on the respective light emitting cells are excited by the light emitted from the active layers, thereby emitting light of a first wavelength range and light of a second wavelength range. Thus, the light emitting cells included in a single light emitting device may outwardly emit two kinds of light.

In the embodiment shown in FIG. **8**, light emitted from the entire light emitting device package may indicate a specific shape of light source. In the embodiment shown in FIG. **9**, light emitted from the entire light emitting device package may be seen in the shape of number "12". Accordingly, as light emitting devices in a light emitting device package are respectively divided into a plurality of light emitting cells and different kinds of fluorescent substances are disposed on the light emitting cells, one light emitting device or the light emitting device package may have any of various shapes rather than a rectangular or square shape, and these shapes may indicate any of specific emblems, such as symbols, letters, numbers or the like.

FIGS. **10**A and **10**B are views showing on and off states of a fourth embodiment of a light emitting device package.

Although the light emitting device package according to the fourth embodiment is similar to the light emitting device package shown in FIG. **8** based on the fact that a single light emitting device includes four light emitting cells, in the present embodiment, all of the light emitting cells may not be identical to one another in terms of an area and/or a shape in comparison with FIGS. **8** and **9** in which all of the light emitting cells have the same area and shape.

The light emitting device package according to the fourth embodiment includes first to fourth light emitting devices **250***a*, **250***b*, **250***c* and **250***d* on a substrate **210**. The first light emitting device **250***a* may include two square light emitting cells **251***a* and **253***a* and two triangular light emitting cells **252***a* and **254***a*, the second light emitting device **250***b* may include two square light emitting cells **252***b* and **253***b* and two triangular light emitting cells **251***b* and **254***b*, the third light emitting device **250***c* may include two square light emitting cells **251***c* and **253***c* and two triangular light emitting cells **252***c* and **254***c*, and the fourth light emitting device **250***d* may include two square light emitting cells **251***d* and **252***d* and two triangular light emitting cells **253***d* and **254***d*.

One light emitting cell **254***a* in the first light emitting device **250***a*, one light emitting cell **254***b* in the second light emitting device **250***b*, one light emitting cell **254***c* in the third light emitting device **250***c* and one light emitting cell **254***d* in the fourth light emitting device **250***d* are provided with a fluorescent substance that is a different kind from that of the other light emitting cells. Different kinds of fluorescent substances emit light of different wavelength ranges when excited by light emitted from active layers of light emitting devices. Thus, a wavelength of light emitted from the four light emitting cells **254***a*, **254***b*, **254***c* and **254***d* differs from a wavelength of light emitted from the other light emitting cells.

Accordingly, as exemplarily shown in (a) of FIG. **10**B, four light emitting devices may indicate emblems corresponding to a leftward arrow and/or a rightward arrow upon receiving current. In particular, when the light emitting device package is used in a lighting device for vehicles, direction indicating emblems may be indicated. In (b) of FIG. **10**B, the case of supplying no current to the light emitting devices is shown.

FIGS. **11**A and **11**B are views showing on and off states of a fifth embodiment of a light emitting device package.

The light emitting device package according to the fifth embodiment is similar to that of the above-described fourth embodiment, but has a difference that one light emitting device includes four light emitting cells having the same area and shape.

A first light emitting device **250***a* may include four light emitting cells **251***a*, **252***a*, **253***a* and **254***a*, a second light emitting device **250***b* may include four light emitting cells **251***b*, **252***b*, **253***b* and **254***b*, a third light emitting device **250***c* may include four light emitting cells **251***c*, **252***c*, **253***c* and **254***c*, and a fourth light emitting device **250***d* may include four light emitting cells **251***d*, **252***d*, **253***d* and **254***d*.

A first fluorescent substance may be disposed on one light emitting cell **254***a*, **253***b*, **252***c* or **251***d* of each of the first light emitting device to the fourth light emitting device **250***a*, **250***b*, **250***c* and **250***d*, and a second fluorescent substance may be disposed on the other light emitting cells. The first fluorescent substance and the second fluorescent substance respectively emit light of a first wavelength range and light of a second wavelength range when excited by light emitted from active layers of the respective light emitting devices **250***a*, **250***b*, **250***c* and **250***d*. Thus, the light emitting cells provided with the first fluorescent substance may outwardly emit a mixture of light emitted from the active layer and light of the first wavelength range, and the light emitting cells provided with the second fluorescent substance may outwardly emit a mixture of light emitted from the active layer and light of the second wavelength range.

Accordingly, as exemplarily shown in (a) of FIG. **11**B, center four light emitting cells and peripheral light emitting

cells indicate different colors when current is supplied to the light emitting devices and, thus, the light emitting devices may constitute, e.g., a signal lamp for a specific emblem or for a specific purpose. For example, in a lighting device for vehicles, a brake lamp and a signal lamp may be integrated to be selectively or wholly turned on or off. In (b) of FIG. **11**B, the case of supplying no current to the light emitting devices is shown.

FIGS. **12**A and **12**B are views showing different configurations of light emitting cells in a light emitting structure of a light emitting device package.

FIG. **12**A shows a vertical light emitting device and FIG. **12**B shows a horizontal light emitting device, each light emitting device including a plurality of light emitting cells placed therein. FIGS. **12**A and **12**B may be vertical cross sectional views taken along direction A-A' of FIG. **4**.

In FIG. **12**A, two light emitting cells **350***b* and **350***d* are separately disposed above a single conductive support substrate **340** that is in turn disposed on a substrate **310**. The light emitting cells **350***b* and **350***d* are spaced apart from each other by a predetermined distance dl. A conductive bonding layer **342** and a second electrode **344** may be disposed on the conductive support substrate **340** and the light emitting cells **350***b* and **350***d* may be disposed on the second electrode **344**.

The predetermined distance dl may be within a range of 10 μm to 50 μm. An excessively great distance has substantially less difference in comparison with manufacturing respective light emitting cells using separate light emitting devices, and an excessively small distance may cause difficulty in separation of light emitting cells during etching.

A first electrode **351***b* may be formed on one light emitting cell **350***b*. The first electrode **351***b* may be bonded to a first bonding pad **310***b* on the substrate **310** via a wire and a fluorescent substance **360***b* may be disposed on the light emitting cell **350***b*. The fluorescent substance **360***b*, for example, may be a green fluorescent substance.

A first electrode **351***d* may be formed on the other light emitting cell **350***d*. The first electrode **351***d* may be bonded to a first bonding pad **310***d* on the substrate **310** via a wire and a fluorescent substance **360***d* may be disposed on the light emitting cell **350***d*. The fluorescent substance **360***d*, for example, may be a yellow fluorescent substance.

In the vertical light emitting device of FIG. **12**A, the first electrode may be formed on a first conductive semiconductor layer in a light emitting structure.

In FIG. **12**B, two light emitting cells **350***b* and **350***d* are separately disposed on an insulating substrate **330** formed of sapphire or the like that is in turn disposed on a substrate **310**. The light emitting cells **350***b* and **350***d* are spaced apart from each other by a predetermined distance dl.

One light emitting cell **350***b* may be subjected, at a region thereof, to mesa-etching such that a first electrode **351***b* is formed on the mesa-etched region, and a second electrode **352***b* may be formed on the light emitting cell **350***b*. The first electrode **351***b* may be bonded to a first bonding pad **310***b* on the substrate **310** via a wire, the second electrode **352***b* may be bonded to a second bonding pad (not shown) on the substrate **310** via a wire, and a fluorescent substance **360***b* may be disposed on the light emitting cell **350***b*. The fluorescent substance **360***b*, for example, may be a green fluorescent substance.

The other light emitting cell **350***d* may be subjected, at a region thereof, to mesa-etching such that a first electrode **351***d* is formed on the mesa-etched region, and a second electrode **352***d* may be formed on the light emitting cell **350***d*. The first electrode **351***d* may be bonded to a first bonding pad **310***d* on the substrate **310** via a wire, the second electrode **352***d* may be bonded to a second bonding pad (not shown) on the substrate **310** via a wire, and a fluorescent substance **360***d* may be disposed on the light emitting cell **350***d*. The fluorescent substance **360***d*, for example, may be a yellow fluorescent substance.

In the horizontal light emitting device of FIG. **12**B, each light emitting cell is mesa-etched such that a second conductive semiconductor layer, an active layer and a portion of a first conductive semiconductor layer are etched to expose a portion of the first conductive semiconductor layer. Then, a second electrode and a first electrode may be disposed respectively on the second conductive semiconductor layer in an unetched region and the exposed first conductive semiconductor layer in the etched region of the light emitting cell.

In the above-described light emitting device packages, the first electrodes and the second electrodes, connected to the respective light emitting cells, may be connected in parallel or may be independent of each other, thereby allowing the respective light emitting cells to be driven individually. As will be appreciated from, e.g., FIGS. **12**A and **12**B, the fluorescent substances may take the form of a conformal coating or a film.

FIGS. **13**A and **13**B are views showing a manufacturing process of the light emitting cells shown in FIGS. **12**A and **12**B and may be identical to the embodiment shown in FIGS. **6**A and **6**B. FIG. **14** is a view showing one embodiment of a lighting device for vehicles containing a light emitting device package.

A lighting device **400** for vehicles according to the embodiment may be configured in such a way that light emitted from a light emitting device module **401** having a light emitting device package is reflected by a reflector **402** and a shade **403** and then passes through a lens **404** to thereby be directed to the rear of a vehicle body. The light emitting device module **401** may include the above-described light emitting device package disposed on a board.

In the above-described lighting device for vehicles, light emitting devices in the light emitting device module may respectively include a plurality of light emitting cells and each light emitting device may emit light of two wavelength ranges.

As is apparent from the above description, a light emitting device package in which a single light emitting device defines a plurality of light emitting cells may emit light of various colors within a narrow space. In addition, the light emitting device package may employ a reduced number of light emitting devices, which enables change of design in a limited space on the substrate and reduction of manufacturing costs.

In addition, as a result of each light emitting device being divided into a plurality of light emitting cells and different kinds of fluorescent substances being disposed on the light emitting cells, one light emitting device or the light emitting device package may have any of various shapes rather than a rectangular or square shape, and these shapes may indicate any of specific emblems, such as symbols, letters, numbers or the like.

Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this disclosure. More particularly, various variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the

component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

What is claimed is:

1. A light emitting device package comprising:

a package body;

a light emitting structure disposed on the package body, the light emitting structure including a first conductive semiconductor layer, an active layer and a second conductive semiconductor layer, the light emitting structure being divided into at least two light emitting cells;

a support substrate located between the package body and the light emitting structure;

a first electrode and a second electrode connected to each of the light emitting cells; and

fluorescent substances disposed on, and separated along, each of the light emitting cells,

wherein at least two layers among the first conductive semiconductor layer, the active layer and the second conductive semiconductor layer included in each of the light emitting cells next to each other are electrically separated from each other.

2. The package according to claim **1**, wherein the respective light emitting cells emit light of the same wavelength range, and at least some portions of the fluorescent substances disposed respectively on the light emitting cells emit light of different wavelength ranges.

3. The package according to claim **1**, wherein the fluorescent substances take the form of a conformal coating or a film.

4. The package according to claim **1**, wherein a distance of the light emitting cells next to each other is 10 μm to 50 μm.

5. The package according to claim **1**, further comprising a substrate for placement of the light emitting structure,

wherein each of the light emitting cells is mesa-etched such that the second conductive semiconductor layer, the active layer and a portion of the first conductive semiconductor layer are etched to expose a portion of the first conductive semiconductor layer, and the second electrode and the first electrode are respectively disposed on the second conductive semiconductor layer in an unetched region and the exposed first conductive semiconductor layer in an etched region of the light emitting cell.

6. The package according to claim **5**, further comprising a conductive support substrate for placement of the light emitting structure,

wherein the first electrode is disposed on the first conductive semiconductor layer of each of the light emitting cells.

7. A lighting device for a vehicle comprising:

a circuit board;

a light emitting device package disposed on the circuit board, the light emitting device package including:

a package body;

at least one light emitting structure disposed on the package body, the light emitting structure including a first conductive semiconductor layer, an active layer and a second conductive semiconductor layer, the light emitting structure being divided into at least two light emitting cells;

a support substrate located between the package body and the light emitting structure;

a first electrode and a second electrode connected to each of the light emitting cells; and

fluorescent substances disposed respectively on the light emitting cells, wherein at least two layers among the first conductive semiconductor layer, the active layer and the second conductive semiconductor layer included in each of the light emitting cells next to each other are electrically separated from each other; and

a lens disposed on the light emitting device package,

wherein the at least one light emitting structure includes two or more light emitting structures, each of the light emitting structures is configured to emit light of a blue wavelength range, and the respective light emitting cells are provided with at least a yellow fluorescent substance and a red fluorescent substance.

8. The device according to claim **7**, wherein each of the light emitting structures includes a first light emitting cell provided with the yellow fluorescent substance and a second light emitting cell provided with a red fluorescent substance, and the first light emitting cell and the second light emitting cell in the light emitting structure are equally arranged.

9. The device according to claim **7**, wherein the first light emitting cell and the second light emitting cell are driven independently of each other.

10. A light emitting device package comprising:

a package body;

at least one light emitting structure disposed on the package body, the light emitting structure including a first conductive semiconductor layer, an active layer and a second conductive semiconductor layer, the light emitting structure being divided into at least two light emitting cells;

a first electrode and a second electrode connected to each of the light emitting cells; and

fluorescent substances disposed respectively on at least some portions of the light emitting cells,

wherein the light emitting cells differ from one another in terms of at least one of a shape of the cells and a distance between the cells, and

wherein the active layers of the respective light emitting cells emit light of the same wavelength range, and at least some portions of the fluorescent substances disposed respectively on the light emitting cells emit light of different wavelength ranges.

11. The package according to claim **10**, wherein the respective light emitting cells have a square shape or a triangular shape.

12. The package according to claim **10**, wherein the light emitting cells include a first light emitting cell provided with a first fluorescent substance to emit light of a first wavelength range and a second light emitting cell provided with a second fluorescent substance to emit light of a second wavelength range, and at least one of the first light emitting cell and the second light emitting cell indicates a specific emblem.

13. The package according to claim **10**, wherein the light emitting cells have different shapes.

14. The package according to claim **10**, wherein the light emitting cells have the same shape.

15. The package according to claim **10**, wherein the light emitting cells are formed by growing a single light emitting structure and then dividing the grown light emitting structure via etching.

16. The package according to claim **10**, wherein the fluorescent substances take the form of a conformal coating or a film.

17. The package according to claim **10**, wherein a distance of the light emitting cells next to each other is 10 μm to 50 μm.

18. The package according to claim **10**, wherein the at least one light emitting structure includes a first light emitting structure and a second light emitting structure, and some light emitting cells in the first light emitting structure and some light emitting cells in the second light emitting structure indicate a direction indicating emblem.

19. The package according to claim 18, wherein some light emitting cells in the first light emitting structure and some light emitting cells in the second light emitting structure indicate a break signal emblem.

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